

## CLAIMS

What is claimed is:

1. A semiconductor device comprising:  
a base which is mainly formed of a semiconductor material;  
an object to be insulated from the base; and  
an insulating film provided between the base and the object for insulating the object from the base, the insulating film being formed of an insulative inorganic material as a main material, the insulative inorganic material containing silicon, oxygen and at least one kind of element other than silicon and oxygen, the insulating film being provided in contact with the base, and the insulating film containing hydrogen atoms,  
wherein the insulating film has a region where A and B satisfy the relation:  $B/A$  is 10 or less in the case where the total concentration of the at least one kind of element in the region is defined as A and the total concentration of hydrogen in the region is defined as B, in which the region is at least a part of the insulating film in the thickness direction thereof.
2. The semiconductor device as claimed in claim 1, wherein the region is unevenly located in the vicinity of an interface between the insulating film and the base.
3. The semiconductor device as claimed in claim 2, wherein, in the case where the average thickness of the insulating film

is defined as Y, the region is located at a portion of the insulating film which resides within the thickness of Y/3 of the insulating film from the interface.

4. The semiconductor device as claimed in claim 1, wherein the at least one kind of element includes at least one of nitrogen, carbon, aluminum, hafnium, zirconium, and germanium.

5. The semiconductor device as claimed in claim 1, wherein the concentration of hydrogen and the concentration of the at least one kind of element are measured by means of Secondary Ion Mass Spectrometry.

6. The semiconductor device as claimed in claim 1, wherein each hydrogen atom in at least a part of the hydrogen atoms is replaced by a deuterium atom.

7. The semiconductor device as claimed in claim 1, wherein the average thickness of the insulating film is 10 nm or less.

8. The semiconductor device as claimed in claim 1, wherein the object is a gate electrode and the insulating film is a gate insulating film for insulating the gate electrode from the base.

9. The semiconductor device as claimed in claim 8, wherein the semiconductor device is adapted to be used under the condition that a gate voltage is applied to the gate electrode so that the electric field intensity in the insulating film is

10 MV/cm or less.

10. The semiconductor device as claimed in claim 8, wherein the maximum leakage current passing through the gate insulating film in the thickness direction thereof that is measured in a state that the gate voltage is applied to the gate electrode so that the electric field intensity in the insulating film is 3 MV/cm or less is  $2 \times 10^{-8}$  A/cm<sup>2</sup> or less.

11. The semiconductor device as claimed in claim 8, wherein the total amount of electrical charges passing through the gate insulating film in the thickness direction thereof until a soft breakdown occurs in the insulating film is 40 C/cm<sup>2</sup> or more.

12. The semiconductor device as claimed in claim 8, wherein the total amount of electrical charges passing through the gate insulating film in the thickness direction thereof until a hard breakdown occurs in the insulating film is 100 C/cm<sup>2</sup> or more.

13. An electronic device comprising the semiconductor device defined by claim 1.

14. An electronic apparatus comprising the electronic device defined by claim 13.

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## AMENDED CLAIMS

[received by the International Bureau on 12 July 2005 (12.07.05);  
original claims 1, 3, 7 and 9-12 amended; original claims 2 and 8 cancelled;  
remaining claims unchanged (3 page)]

What is claimed is:

1. (Currently Amended) A semiconductor device comprising:  
a base which is mainly formed of a semiconductor material;  
an object to be insulated from the base; and  
an insulating film provided between the base and the  
object for insulating the object from the base, the insulating  
film being formed of an insulative inorganic material as a main  
material, the insulative inorganic material containing silicon,  
oxygen and at least one kind of element other than silicon and  
oxygen, the insulating film being provided in contact with the  
base, the insulating film containing hydrogen atoms, and the  
object being a gate electrode and the insulating film being a  
gate insulating film for insulating the gate electrode from the  
base,

wherein the gate insulating film has a region in the  
vicinity of an interface between the gate insulating film and  
the base where A and B satisfy the relation:  $B/A$  is 10 or less  
(here, B is more than A) in the case where the total concentration  
of the at least one kind of element in the region is defined  
as A and the total concentration of hydrogen in the region is  
defined as B, in which the region is at least a part of the gate  
insulating film in the thickness direction thereof.

2. (Deleted)

3. (Currently Amended) The semiconductor device as claimed in  
claim 1, wherein, in the case where the average thickness of  
the gate insulating film is defined as Y, the region is located  
at a portion of the gate insulating film which resides within

the thickness of  $Y/3$  of the gate insulating film from the interface.

4. (Original) The semiconductor device as claimed in claim 1, wherein the at least one kind of element includes at least one of nitrogen, carbon, aluminum, hafnium, zirconium, and germanium.

5. (Original) The semiconductor device as claimed in claim 1, wherein the concentration of hydrogen and the concentration of the at least one kind of element are measured by means of Secondary Ion Mass Spectrometry.

6. (Original) The semiconductor device as claimed in claim 1, wherein each hydrogen atom in at least a part of the hydrogen atoms is replaced by a deuterium atom.

7. (Currently Amended) The semiconductor device as claimed in claim 1, wherein the average thickness of the gate insulating film is 10 nm or less.

8. (Deleted)

9. (Currently Amended) The semiconductor device as claimed in claim 1, wherein the semiconductor device is adapted to be used under the condition that a gate voltage is applied to the gate electrode so that the electric field intensity in the gate insulating film is 10 MV/cm or less.

10. (Currently Amended) The semiconductor device as claimed in claim 1, wherein the maximum leakage current passing through the gate insulating film in the thickness direction thereof that

is measured in a state that the gate voltage is applied to the gate electrode so that the electric field intensity in the gate insulating film is 3 MV/cm or less is  $2 \times 10^{-8}$  A/cm<sup>2</sup> or less.

11. (Currently Amended) The semiconductor device as claimed in claim 1, wherein the total amount of electrical charges passing through the gate insulating film in the thickness direction thereof until a soft breakdown occurs in the gate insulating film is 40 C/cm<sup>2</sup> or more.

12. (Currently Amended) The semiconductor device as claimed in claim 1, wherein the total amount of electrical charges passing through the gate insulating film in the thickness direction thereof until a hard breakdown occurs in the gate insulating film is 100 C/cm<sup>2</sup> or more.

13. (Original) An electronic device comprising the semiconductor device defined by claim 1.

14. (Original) An electronic apparatus comprising the electronic device defined by claim 13.

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